IEC 61109

Edition 3.0 2025-02
COMMENTED VERSION

INTERNATIONAL STANDARD

Insulators for overhead lines – Composite suspension and tension insulators with AC voltage greater than 1 000 V and DC voltage greater than 1 500 V – Definitions, test methods and acceptance criteria

IEC 61109:2025-02 CMV(en)

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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 29.080.10

ISBN 978-2-8327-0286-4

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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FOREWORD

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This commented version (CMV) of the official standard IEC 61109:2025 edition 3.0 allows the user to identify the changes made to the previous IEC 61109:2008 edition 2.0. Furthermore, comments from IEC TC 36 experts are provided to explain the reasons of the most relevant changes, or to clarify any part of the content.

A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text. Experts' comments are identified by a blue-background number. Mouse over a number to display a pop-up note with the comment.

This publication contains the CMV and the official standard. The full list of comments is available at the end of the CMV.

IEC 61109 has been prepared by subcommittee 36B: Insulators for overhead lines, of IEC technical committee 36: Insulators. It is an International Standard.

This third edition cancels and replaces the second edition published in 2008. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) extension of this document to apply both to AC and DC systems;
b) modifications of Clause 3, Terms, definitions and abbreviations;
c) removal of Clause 7, Hybrid insulators, from this document;
d) modifications of tests procedures recently included in IEC 62217 (hydrophobicity transfer test, stress corrosion, water diffusion test on the core with housing);
e) modifications on environmental conditions;
f) modifications on classification of tests and include the relevance of the interfaces;
g) clarification and modification of the parameters determining the need to repeat design and type tests;
h) revision of Table 1;
i) revision of electrical type tests;
j) revision of re-testing procedure of sample test;
k) addition of a new Annex D on electric field control for AC;
l) addition of a new Annex E on typical sketch for composite insulators assembly;
m) addition of a new Annex F on mechanical evaluation of the adhesion between core and housing;
n) addition of a new Annex G on applicability of design- and type tests for DC applications.

The text of this International Standard is based on the following documents:

Draft	Report on voting
36/609/FDIS	36/611/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

This International Standard is to be used in conjunction with IEC 62217:2012.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

INTRODUCTION

Composite suspension and tension **2** insulators (in the following the term "composite insulator" is used) consist of fibreglass insulating core, bearing the mechanical load protected by a polymeric housing, the load being transmitted to the core by metallic end fittings. Despite these common features, the materials used and the ~~construction~~ design details and manufacturing process used by different manufacturers may differ.

Some tests have been grouped together as "Design tests", to be performed only once on insulators which satisfy the same design conditions. For all design tests of these composite ~~suspension and tension~~ insulators, the appropriate common clauses defined in IEC 62217 are applied. As far as practical, the influence of time on the electrical and mechanical properties of its components (core ~~material~~, housing, interfaces etc.) and of the complete composite insulators has been considered in specifying the design tests to ensure a satisfactory lifetime under normally known stress conditions of transmission lines. Explanation of the principles of the damage limit, load coordination and testing are presented in Annex A.

It has not been considered useful to specify a power arc test as a mandatory test. The test parameters are manifold and can have very different values depending on the configurations of the network and the supports and on the design of arc-protection devices. The heating effect of power arcs ~~should~~ need to be considered in the design of metal fittings. Critical damage to the metal fittings resulting from the magnitude and duration of the short-circuit current can be avoided by properly designed arc-protection devices. This document, however, does not exclude the possibility of a power arc test by agreement between the ~~user and~~ manufacturer and customer. IEC 61467 gives details on AC power arc testing of complete insulator sets, that match their configuration with actual protective and string fittings, to recreate the real electromagnetic field affecting the arc movement.

~~Composite insulators are used in both a.c. and d.c. applications. In spite of this fact, a specific tracking and erosion test procedure for d.c. applications as a design test has not yet been defined and accepted. The 1 000 h a.c. tracking and erosion test of IEC 62217 is used to establish a minimum requirement for the tracking resistance of the housing material.~~

~~The mechanism of brittle fracture has been investigated by CIGRE B2.03[1] and conclusions are published in [2, 3]. Brittle fracture is a result of stress corrosion induced by internal or external acid attack on the resin bonded glass fibre core. CIGRE D1.14 has developed a test procedure for core materials based on time-load tests on assembled cores exposed to acid, along with chemical analysis methods to verify the resistance against acid attack [4]. In parallel IEC TC36WG 12 is studying preventive and predictive measures.~~

This document covers both AC and DC composite insulators. Before the appropriate standard for DC applications is issued, the majority of tests listed in this document can also be applicable for DC (Annex G). Due to the difference in AC and DC tracking performance, a specific tracking and erosion test procedure for DC applications as a design test is planned to be developed. The 1 000 h AC tracking and erosion test of IEC 62217 can be used only to establish a minimum requirement for the tracking and erosion resistance. This 1 000 h salt fog tracking and erosion test is considered as a screening test intended to reject materials in combination with the design which are inadequate. Tracking and erosion tests are not intended to evaluate long term performance of insulators. Such tests, e.g. the 5 000 h multiple stress test and wheel test in IEC TR 62730 [1][2], or other tests intended for research or sometimes used as a supplementary design test, are not considered in this document.

Composite suspension and tension insulators are, in general, not intended for torsion or other non-tensile loads. However, due to consideration to non-standard applications (interphase

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~~[1] International Council on Large High Voltage Electric Systems: Working Group B2.03.~~

[2] Numbers in square brackets refer to the bibliography.

spacers etc.) loads during handling and installation have to be considered in the design. Guidance on non-standard loads is given in Annex C.

Wherever possible, IEC Guide 111 [2] has been followed for the drafting of this document.

INSULATORS FOR OVERHEAD LINES COMPOSITE SUSPENSION AND TENSION INSULATORS ~~FOR A.C. SYSTEMS~~ WITH ~~A NOMINAL~~ AC VOLTAGE GREATER THAN 1 000 V AND DC VOLTAGE GREATER THAN 1 500 V – DEFINITIONS, TEST METHODS AND ACCEPTANCE CRITERIA

1 Scope ~~and object~~

This International Standard applies to composite ~~suspension/tension~~ insulators for overhead lines consisting of a load-bearing cylindrical insulating solid core consisting of fibres – usually glass – in a resin-based matrix, a housing (~~outside~~ surrounding the insulating core) made of polymeric material and metal end fittings permanently attached to the insulating core.

Composite insulators covered by this document are intended for use as suspension/tension line insulators, but ~~it should be noted that~~ these insulators ~~can~~ could occasionally be subjected to compression or bending, for example when used as ~~phase~~ interphase-spacers. Guidance on such loads is outlined in Annex C.

~~This standard can be applied in part to hybrid composite insulators where the core is made of a homogeneous material (porcelain, resin), see Clause 8.~~

The object of this document is to

– define the terms used,
– ~~prescribe~~ specify test methods,
– ~~prescribe~~ specify acceptance criteria.

This document does not include requirements dealing with the choice of insulators for specific operating conditions or environments beyond normal environmental conditions defined in Table 1.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60060-1, *High-voltage test techniques – Part 1: General definitions and test requirements*

IEC 60383-1, *Insulators for overhead lines with a nominal voltage above 1000 V – Part 1: Ceramic or glass insulator units for AC systems – Definitions, test methods and acceptance criteria*

IEC 60383-2, *Insulators for overhead lines with a nominal voltage above 1 000 V – Part 2: Insulator strings and insulator sets for AC systems – Definitions, test methods and acceptance criteria*

IEC 60437, *Radio interference test on high-voltage insulators*

IEC 61284, *Overhead lines – Requirements and tests for fittings*

IEC 61466-1, *Composite string insulator units for overhead lines with a nominal voltage greater than 1 000 V – Part 1: Standard strength classes and end fittings*

IEC 61467, *Insulators for overhead lines – Insulator strings and sets for lines with a nominal voltage greater than 1 000 V – AC power arc tests*

IEC 62217:~~2005~~[3], *Polymeric HV insulators for indoor and outdoor use ~~with a nominal voltage > 1 000 V~~ – General definitions, test methods and acceptance criteria*

IEC 62231, *Composite station post insulators for substations with AC voltages greater than 1 000 V up to 245 kV – Definitions, test methods and acceptance criteria*

ISO 3452 (all parts), *Non-destructive testing – Penetrant testing*

3 Terms, definitions and abbreviated terms

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at https://www.electropedia.org/
- ISO Online browsing platform: available at https://www.iso.org/obp

Note 1 to entry: Certain terms from IEC 62217:2012 are reproduced here for ease of reference. Additional definitions applicable to insulators can be found in IEC 60050-471 [3].

3.1 Terms and definitions

3.1.1
polymeric insulator
insulator whose insulating body consists of at least one organic based material

Note 1 to entry: Polymeric insulators are also known as non-ceramic insulators.

Note 2 to entry: Coupling devices may be attached to the ends of the insulating body.

[SOURCE: IEC 60050-471:2007, 471-01-13]

3.1.2
composite insulator
insulator made of at least two insulating parts, namely a core and a housing equipped with ~~metal~~ end fittings

Note 1 to entry: Composite insulators can consist either of individual sheds mounted on the core, with or without an intermediate sheath, or alternatively, of a housing directly moulded or cast in one or several pieces on to the core.

[SOURCE: IEC 60050-471:2007, 471-01-02]

3.1.3
core (of ~~a composite~~ an insulator)
~~internal insulating part of a composite insulator which is designed to ensure the mechanical characteristics~~

~~NOTE The core usually consists of either fibres (e.g. glass) which are positioned in a resin based matrix or a homogeneous insulating material (e.g. porcelain or resin).~~

[3] Under preparation. Stage at the time of publication: IEC/RFDIS 62217:2025.

~~[IEV 471-01-03, modified]~~

central insulating part of an insulator which provides the mechanical characteristics

Note 1 to entry: The housing and sheds are not part of the core.

[SOURCE: IEC 60050-471:2007, 471-01-03]

3.1.4
insulator trunk
central insulating part of an insulator from which the sheds project

Note 1 to entry: Also known as shank on smaller insulators.

[SOURCE: IEC 60050-471:2007, 471-01-11]

3.1.5
housing
external insulating part of composite insulator providing the necessary creepage distance and ~~protecting~~ protects the core from the environment

Note 1 to entry: An intermediate sheath made of insulating material may be part of the housing.

[SOURCE: IEC 60050-471:2007, 471-01-09]

3.1.6
shed (of an insulator)
insulating part, projecting from the insulator trunk, intended to increase the creepage distance

Note 1 to entry: The shed can be with or without under-ribs.

[SOURCE: IEC 60050-471:2007, 471-01-15]

3.1.7
interface
contact surface between the different materials

Note 1 to entry: Various interfaces exist in composite insulators, e.g.:

– between housing and ~~fixing devices~~ end fittings;
– between various parts of the housing; e.g. between separately manufactured sheds, or between sheath and sheds;
– between core and housing;
– between sealant and core;
– between sealant and end fittings.

(Annex E: Typical sketches for composite insulator assemblies)

~~[Definition 3.10 of IEC 62217]~~

[SOURCE: IEC 62217:—, 3.11, modified – "contact" added in definition, Note 1 to entry modified]

3.1.8
end fitting
integral component or formed part of an insulator intended to connect it to a supporting structure, or to a conductor, or to an item of equipment, or to another insulator

Note 1 to entry: Where the end fitting is metallic, in general the term "metal fitting" is used.

Note 2 to entry: Standard end fittings are defined in IEC 61466-1.

[SOURCE: IEC 60050-471:2007, 471-01-06]

3.1.9
connection zone
zone where the mechanical load is transmitted between the ~~insulating body~~ core and the end fitting

~~[Definition 3.12 of IEC 62217]~~

[SOURCE: IEC 62217:2012, 3.13, modified – "insulating body and the fixing device" replaced by "core and the end fitting"]

3.1.10
coupling
part of the end fitting which transmits the load to the accessories external to the insulator

~~[Definition 3.13 of IEC 62217, modified]~~

[SOURCE: IEC 62217:2012, 3.14, modified – "fixing device" replaced by "end fitting", "hardware" replaced by "accessories"]

3.1.11
creepage distance
shortest distance or the sum of the shortest distances along the surface on an insulator between two conductive parts which normally have the operating voltage between them

[SOURCE: IEC 60050-471:2007, 471-01-04]

3.1.12
arcing distance
shortest distance in the air external to the insulator between the metallic parts which normally have the operating voltage between them

Note 1 to entry: The term "dry arcing distance" is also used.

[SOURCE: IEC 60050-471:2007, 471-01-01]

3.1.13
specified mechanical load
SML
withstand load, specified by the manufacturer, which is used for mechanical tests in this document

3.1.14
routine test load
RTL
load applied to all assembled composite insulators during a routine mechanical test

3.1.15
mechanical failing load
maximum load that is reached when the insulator is tested under the ~~prescribed~~ standard conditions

[SOURCE: IEC 60050-471:2007, 471-01-12, modified – "prescribed" replaced by "standard", Note 1 to entry removed]